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W.J. Zontine

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# Urine Specific Gravity

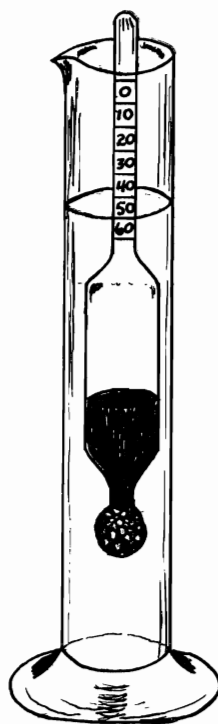
Dr. W. J. Zontine, D.V.M.

IT HAS OFTEN BEEN STATED that the most important single test in a urinalysis is the determination of specific gravity. No other test gives as much information regarding kidney function in dogs as quickly while utilizing so little time and equipment, requiring only a urinometer. Veterinarians should purchase the infant size instrument since the quantity of urine obtained is often too small to float a large urinometer. It is wise to check any new instrument for accuracy using distilled water as a standard or some other liquid of known specific gravity. Occasionally the quantity of urine obtained is inadequate to float even the smallest urinometer. In this event an estimation of specific gravity can be made by diluting the urine with a known quantity of distilled water and then multiplying the last two figures of the reading by the dilution factor. For example, four cc of urine mixed with eight cc of water yields a dilution factor of three. If the specific gravity of the dilution is 1.012, then  $1.012 \times 3 = 1.036$ .

There are many factors which affect urine specific gravity such as hormonal control by the pituitary gland, the solute content of the filtrate, and tubal reabsorption of water. The effect of these can be seen by a review of basic renal physiology. As blood flows through the glomerulus a nearly protein-free filtrate is produced having the same specific gravity as serum, 1.010. As the filtrate progresses down the

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Dr. W. J. Zontine has a predominantly small animal practice in Lancaster, California.



Midget Urinometer

tubule, substances are removed or added as required by the body. One of the substances removed in greatest quantity is water. In fact, under normal circumstances, of every 100 cc of filtrate which clears the glomerulus, only 1 cc ends up as urine, the other 99 cc being absorbed to

maintain body water balance. Although the normal urine specific gravity in dogs is 1.025 — 1.040, the canine kidney has the ability to concentrate to almost 1.060 and to dilute to nearly distilled water, 1.000. So, in examining urine samples collected at random during the day a wide variation of normal specific gravities might be seen.

Let us see what occurs to urine specific gravity under the stress of various pathological conditions. The posterior pituitary gland through the secretion of an anti-diuretic hormone (ADH) plays a very important part in the renal control of water loss. Damage to this endocrine gland (as in diabetes insipidus) upsets the normal diuretic-antidiuretic hormone balance resulting in a loss of the antidiuretic portion and a consequent diuresis. Large quantities of a very dilute urine in the specific gravity range of 1.005 are passed. The kidney cells are functional but the normal hormonal control is lacking.

Polyuria is also the symptom observed when large quantities of dissolved material must be excreted by the kidneys. Diabetes mellitus is a classic example of this type of condition in which large amounts of sugar must be excreted. In order to keep this increased amount of solid in solution large quantities of water are required, accounting for the diuresis of diabetes. The specific gravity in this case is very high, 1.050 — 1.060, because of the solute load. The polyuria associated with an increased solute load holds true for electrolytes as well. It is a tenet of medicine that water excretion is accompanied by sodium excretion and that water retention is associated with sodium retention. Therefore, any situation which results in excretion of abnormally large quantities of sodium will stimulate excessive urinary losses of water. Examples of such situations are adrenal dysfunction and excretion of edematous fluids.

In dogs the commonest reason for alteration of urine specific gravity is nephritis. In such cases the renal cells are unable to reabsorb water from the glomerular filtrate resulting in polyuria. Consequently, polydipsia develops from the body's attempt to replace the water lost in the urine. Another affect of the water loss is

the sodium loss and a resultant acidosis. As damage progresses in the renal tubule the inability of the kidney to concentrate urine by reabsorbing water is seen by a lowering of the specific gravity from a normal of 1.025 — 1.040 down to the point of fixation, 1.010 (1.008 — 1.012). The specific gravity remains at this point unless renal function returns which is heralded by a rise in the reading to the normal range. Note that the point of fixation, 1.010, is the same as when the filtrate originally cleared the glomerulus. This fact forms the basis of the urine concentration test.

In performing the urine concentration test the dog is deprived of water for a 12-18 hour period and the specific gravity of the first urine passed is measured. A normally functioning kidney should concentrate the urine above 1.025. Readings less than 1.020 are suggestive of renal damage and a reading of 1.010 (1.008-1.012) indicates a point of fixation typical of kidney damage. Once the urine specific gravity reaches the point of fixation, the concentration test loses its value as this test does not indicate how much damage has occurred but merely that renal disability is present. Should the disease process result in chronic nephritis, the specific gravity remains fixed at 1.010. A rising specific gravity indicates the return of normal kidney function. Urine samples taken at random during the day can often be confusing as low or high specific gravity readings might be simply normal dilution or concentration on the part of the kidney rather than a pathological entity. So whenever possible a urine concentration test should be run to test kidney function. The only contraindication for this test is when deprivation of water might be dangerous to the animal.

#### Summary

No urinalysis is valid without a test for specific gravity as this examination gives more information as to kidney function than any other single test. The urine concentration test is very simple to perform and should be done whenever possible. Urinometers should be checked for accuracy as an exact reading is important in this examination.

*End*